array of LEDs **434** are coupled at one end of the diffuser and a reflective back surface **438** is designed to evenly distribute light as it is directed through the interface.

[0168] An enlarged top view of a diffuser and light pipe system **450** for backlight illumination of a display is illustrated in **FIG. 7D**. The light source **452** such as three light emitting diodes is coupled to an expanding light pipe **454**. The light pipe **454** directs the light into the side of a reflecting element or diffuser **458**, as illustrated in **FIG. 7E**. A BEF film referenced above can be used between the light pipe **454** and element and reflective element **458**. The sides and bottoms of the elements can be beveled at **456** to further reduce the volume occupied by this portion of the optical system. A reflective surface or mirror **464** serves to reflect light towards diffuser **462** and through the display **460**.

[0169] In another embodiment of an LED display illumination system **1420** as shown in **FIG. 7**F, the display **1422** is coupled to an angled diffuser **1426** at interface **1430**. The linear array of LEDs are inserted into slot **1424** to couple light into one end of the diffuser and a reflective back surface **1428** is designed to evenly distribute light as it is directed through the interface. The increase thickness and shortness of the body of the angled diffuser **1426** increases the coupling efficiency of the element **1426** to display and thus increases the foot-lamberts (fL) of light produced per amount of power.

[0170] In another embodiment of an LED display illumination system as shown in **FIG. 7**G, the display **1432** is coupled to an angled diffuser **1436** at interface **1440**. The linear array of LEDs are inserted at slot **1434** at one end of the diffuser and a reflective back surface **1438** is designed to evenly distribute light as it is directed through the interface. Similarly to the previous embodiment, the increased thickness and shortness of the body of the angled diffuser **1436** increases the coupling efficiency of the backlight system.

[0171] Illustrated in connection with **FIG. 8A** is a cellular telephone **200** having a magnified microdisplay in accordance with the invention. The display can be included in a base portion **210** of a "flip-phone" along with keypad **218** and microphone **220**. The speaker **206**, or the display or a second display as well as additional circuitry can be included in second portion **208** that rotates relative to the base **210**. An antenna **204** can telescope out of the base for improved wireless reception. A battery is housed at **212**. A lens **202** can be viewed by the user while holding the speaker to his or her ear thus enabling both viewing and voice transmission at the same time. The display can be turned on or off at switch **216** to save battery life when the display is not in use. The magnification can be adjusted at knob **214**.

[0172] Additionally, a small camera **215** such as a charge coupled device (CCD), CMOS imaging sensor or other solid state imaging sensor can be mounted on a telescoping element to provide an imaging or video-conferencing capability. The camera can be pivoted so that the user can point and hold the camera in any selected direction. The image generated can be seen on the display and/or transmitted to a remote location, selected buttons or touch pad keys **218** can be used as a mouse control for the display.

[0173] Referring to **FIGS. 8B and 8C**, an alternative embodiment of a cellular telephone **222** having a magnified microdisplay in accordance with the invention is shown in open and closed perspective views respectively. The cellular "flip-phone"**222** has a base portion **224** and a flip portion **226**. The base portion **224** has a keypad **228** a speaker **230**, and an antenna **232**. The base portion **224** may include an alphanumeric display for seeing the telephone number as it is being entered. The flip portion **226** pivots from the base portion **224** and includes a microphone **234**, shown in hidden line in **FIG. 8B**. The microdisplay-is located in a module **238** which rotates relative to the flip portion **226**. The module or pod **238** is flush with the flip portion **226** when in a stored position, such that the viewing port **240** is protected by the flip portion **226**, as seen in **FIG. 8C**. When the "flip-phone"**222** is in use, the pod **238** is rotated generally **90** degrees from the stored closed position, such that a viewing port **240** is exposed and in the user's line of sight. The flip portion **226** spaces the microdisplay the proper distance from the base portion **224** to facility viewing.

[0174] Alternatively to the base portion **224** having an alphanumeric display, the telephone **222** can have software which can vary the image size on the microdisplay. The software can create low resolution image with large characters, such as illustrated in **FIG. 8D**. This resolution is primarily used when the microdisplay is viewed from 6 to 18 inches. When the user is inputting the telephone number on the keypad **228**, the user's eye is typically that distance from the microdisplay as represented in **FIG. 8E**. The software can create high resolution small characters, and typically does, such as represented in **FIG. 8F**. This resolution is primarily implemented when the user's eye is 1 to 6 inches from the microdisplay, as represented in **FIG. 8**G, such as when the user is speaking on the phone. The software can automatically switch after the telephone number is dialed or a button can be pushed.

[0175] Referring to **FIGS. 8H and 8I**, an alternative embodiment of a cellular, cordless or standard telephone handset **1222** having a magnified microdisplay in accordance with the invention is shown. The telephone **1222** has a base portion **1224** and a display portion **1226** formed as an integral piece. The base portion **1224** can include a keypad **1228** or virtual keypad, a speaker **1230**, and can include an antenna **1232**. The base portion **1224** can include an alphanumeric display for seeing the telephone number as it is being entered. An alternative to the alphanumeric display is for the microdisplay to change resolution as described above or overlay enlarged numerical information on images being displayed.

[0176] The display portion **1226** of the telephone **1222** projects from the base portion **1224**. The display portion **1226** includes the microdisplay with a lens **1236** that can extend substantially orthogonal to the plane of the base portion **1224**. A microphone, located behind an opening **1234**, can be generally located where the display portion **1226** and the base portion **1224** merge. The telephone **1222** can have a battery **1238** which is accessible from a palm receiving portion of the base **1224**, as seen in **FIG. 8I**. This embodiment and other personal communication devices described in connection with other embodiments can utilize a high gain rear projection screen **1235** that can be positioned relative to the lens **1236** such that several people can observe the displayed image at one time. This option can include a high brightness switch for the backlight which can be manually actuated to draw more power to improve clarity of the image. The screen **1235** can be 1 and 4 inches in